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Relating Hume's Epistemic Theory of Causality to Habituation in Contemporary Neuroscience

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Abstract

This purpose of this thesis is to empirically verify Hume's theory of our epistemic knowledge of causality in contemporary models of habituation in neuroscience. By using contemporary habituation as supplementary evidence to Hume's theory I hope to demonstrate how this verification strengthens his argument, which is particularly important considering Hume's empiricist roots. To accomplish this, I will investigate the Early Modern science used to inform Hume's theory, explicate Hume's theory, and then relate it to studies of the amygdala, hippocampus and the peripheral nervous system in cognitive neuroscience. Drawing interdisciplinary connections across theories in philosophy and the empirical sciences can give us the most plausible, accurate and holistic explanation in answering some of life's biggest questions.

Introduction

David Hume was a Scottish philosopher who lived from 1711-1776. He was active during the Age of Enlightenment in Europe; a time when philosophy, science and politics were undergoing a radical shift from the traditional entrenched monarchy and strict religious values to a reverence for science, freedom and reason above an appeal to authority. Hume is considered to be one of the most important figures in the Scottish Enlightenment and in British Empiricism. Like any great empiricist, Hume was very much inspired by the world around him. Because the world around him was defined by such an unprecedented, dynamic exchange of scientific and philosophical ideas, he had a lot to be inspired by. Sir Isaac Newton, for example, had just reconceptualized the universe itself with the *Philosophiae Naturalis Principia Mathematica* in 1687. Rather than deferring to an Ancient Greek or Judeo Christian construction of the universe as thinkers had done before, he proved through the scientific method that planetary systems deferred to orbits produced by the laws of gravity. Hume was greatly inspired by Newton and thinkers like him that utilized scientific evidence to develop a theory about the world, and artfully made use of the modern science of the time in the development of his own theories. He expressed in the Introduction of *A Treatise of Human Nature* that all sciences ultimately relate to the study of human nature, and that we can apply experimental scientific methods to this study to this pursuit (Schliesser, 2007). One theory this process of scientific verification is present in is his theory of epistemic causality. As an empiricist, David Hume believes we gain knowledge of causality empirically through the process of habituating to cause and effect relationships that exist externally. The more we experience a certain causal relationship, the stronger our belief in that relationship becomes. While we know this view is empirically verified by the neuroscience

available to him at the time, Hume's theory can also be corroborated with contemporary models of habituation that exist in cognitive neuroscience. This is compelling because his theory stand the test of time, and thus strengthens this view as being reflective of reality.

Problem statement

This thesis is not designed to address a problem per se in the discipline of philosophy, but rather aims to point out a novel interdisciplinary connection between Hume's theory and contemporary neuroscience. In Book One, Part Two of *A Treatise of Human Nature* and Sections IV-V of *An Enquiry Concerning Human Understanding*, Hume postulates on the origin of our epistemic knowledge of causality. He believes that we come to understand and expect certain effects to follow certain causes because of the process of habituation. When we have repeated experience of a certain causal relationship, there is a higher probability we will expect that relationship to mirror our past experience of it. If we experience the same causal relationship enough times, we will develop an automatic expectation of certain effects. In fact, it is argued by some that he actually presupposed the reader of his work to be already familiar with the neuroscience of the time. He figured anyone interested in reading his work would be an intellectual, and therefore up to date with modern science. Because of the fact that *The Treatise* was published in 1739-40, the neuroscience used as the foundation of his explanation of habit is a bit out of date. The project of my thesis will be to remap Hume's conception of our epistemic knowledge of causality through habituation onto contemporary accounts of the mechanisms behind habituation based on empirical evidence such as modern scientific theories and experimentation.

Theoretical background- Philosophy

When Hume is considering the conclusions drawn from our past experiences of cause and effect, he wants to dig deeper and understand the foundation of experience itself. In the *Treatise*, Hume describes how when we first come into contact with some sort of stimulus, we immediately form a perception of it (Treatise, Book I, Part I, Section I). A perception can be understood in broad terms to be any sort of mental content, of which there are two kinds: impressions and ideas. An impression is a vivid perception of some sort of tactile or visceral sensation that arises immediately. The mind makes a copy of this impression, and after the sensory experience of the initial impression dissipates, one is left with an idea. Ideas are the images that are produced from these copies of impressions that can be utilized later in a reasoning process. These ideas are coherent and orderly because the mind joins ideas together. They are unified by a gentle force called association that connects them. This occurs naturally within the mind in a manner that is not immediately available to our understanding (Treatise Book I, Part I, Section I). When two ideas are associated with one another, the presence of one will immediately produce the presence of the other, like the smell of pine needles and Christmas. The more we smell pine needles around Christmas time, the more reinforced this association becomes. Association is the only way our ideas are able to connect (Wright, Ch V, Section XIX). There are three different principles of association: resemblance, spatial and temporal contiguity, and causation. The first type of is resemblance, or our ability to connect ideas with something familiar. The second type is connecting ideas based on their contiguity in space in time, which is relating ideas to a specific time and/or place. The focus of this thesis is on the third principle of causation.

The conception of causality Hume utilizes is the Greek conception of *Aitia*, or the relationship between observable propositional items like events or actions in which the effect is contingent upon and temporally subordinate to the cause (Frede, 1987). The language used to describe his account the mind and how it relates to other ideas demonstrates his presupposition of Cartesian psychophysics and Malebranche's theory of connecting ideas (Wright, Ch V, Section XIX). Like his predecessors, he believed that repeated experience of association would have a physiological effect on the brain (Wright, Ch V, Section XIX). In addition to Descartes and Malebranche, Locke, who also presupposed Cartesian psychophysics, put forth a theory of habituation in the *Essay Concerning Human Understanding*, stating that custom develops our thinking and ultimately determines the will (*Essay* 2, 33, 6). Descartes, Locke and Malebranche laid the intellectual groundwork that allows Hume to develop his theory linking habituation, association and causality with the brain. He believed we come to understand these relations by associating propositional items as being causally linked, and habituating to our experience of the subsequent effects. Knowledge of these relations are not implicit to the object of change, but are rooted in repeated experience of associating propositional items with the change that results. We can only have knowledge of the most basic qualities of an object through our sensory experience of impressions. These are the features of an object that can be understood purely through our sensory faculties. However, we cannot understand the underlying force of an object that carries out change in a perpetually moving body through pure sensory qualities or reason (*Enquiry* Section V, Part 1). This is essentially the effect an object has on another object, Hume argues we understand this process through our collective experience of a certain effect. We cannot know these effects through rational processes or observation because the influence these effects have

cannot be understood with our finite human minds, they are concealed by Nature. Because they are concealed, we cannot access them with our reasoning processes or sensory faculties. He argues that knowledge built off of our experience of cause and effect relations comes from habituation rather than any process of deduction (*Enquiry* Section V, Part I). Hume goes on in this section to explain that even if one were to develop a perfect expectation of causal relations, one still would not understand the underlying force that carries out change from one object to another. We have knowledge of causal relations because our repeated experience yields results we come to expect. The more we experience causal relations, the more habituated we become to them, the better our understanding becomes. Our belief in the uniformity of these relations should be understood in proportion to the strength of evidence presented to us, which is a classic Humean assertion. There is no necessary link that causes the future to resemble the past, which is why there are instances of contrary examples that do not exist in logic. If we could rely on a logical deduction to inform us that future instances of an effect will resemble past instances, there would not exist contrary examples of causal relations. Rather, we rely on degrees of probability based on our past experience of a certain effect to understand and have knowledge of them. This is how we gain knowledge of a causal relationship. This process is not exclusive to humans, and Hume believes we can learn a lot from animals and animal behavior. Animals also understand causality in terms of habituation, something anyone who has trained an animal is already in touch with. Animals learn how to do things through the repetition of a given action and the subsequent positive reinforcement of it. This illustrates the reinforcement of a causal relationship through the process of habituation, just like what we see with humans (Enquiry, Part III, Section IX).

The human actions that bring about certain causal relationships in the first place are rooted in our passions, or what we would today call emotions. Passions are an impression of reflection. Under Hume's view, passions arise from our various experiences of pain and pleasure. There are two types of passions- direct passions and indirect passions (Treatise Book I, Part I, Section I). Direct passions includes phenomena such as desire, fear or happiness that are viscerally derived from experiences of pleasure and pain. Our bodily instincts and appetites also fall under this category. These direct passions arise immediately within us. The happiness you experience when seeing an old friend for the first time in awhile is instantaneous, not logically derived or deduced as the passions exist separately from reason. They are distinct from indirect passions in that they have the causal ability to bring about change. Indirect passions are phenomena such as love and hate that arise from our direct passions. These passions are produced when our direct passions interact external factors such as objects or other people. Unlike direct passions, love and hate do not cause actions, which is what makes them indirect. Human actions and therefore human behavior are the immediate product of our direct passions. Because passions are an impression, ideas are formed within us based on the experiences of pleasure and pain they generate. These are the ideas that motivate all of our actions. The will, therefore, always operates to avoid pain and maximize pleasure (Treatise Book II, Part III, Section IX). When we become habituated and accustomed to a certain set of ideas about what 'avoid pain, seek pleasure' means to each of us as members of our own respective experiences and societies, we develop beliefs about the right and wrong way to do things. This may be why some people become so destructively defensive of their beliefs despite logic or reason, their beliefs are the product of their passions. Our human actions and beliefs are contingent solely upon the passions, so we must account for them in our understanding of causal relations.

Empirical background- Neuroscience

It can be difficult to see what this account of causality has to do with contemporary neuroscience, which is precisely what makes the connection so novel. But upon examination of scientific literature, it is clear that we do in fact understand causality through habituation just like Hume postulated. He was also correct in postulating that all species of animals down to single-celled organisms (and at least one species of plant) learn to respond to their environment through the process of habituation (Thompson, 2009). Habituation is described as a decrease in response to repeated stimulus in scientific literature (Thompson, 2009). In humans, this process takes place in the amygdala, and can be observed in action during scientific experiments using PET scans and fMRI scans (Plichta, 2014). The amygdala is located in the limbic system of the brain which is associated with memory, decision making, and emotional responses. Because of the amygdala's locus in the limbic system, Hume was also correct about the passions being the basis of our beliefs, actions, and our understanding of causality. The amygdala works in conjunction with the nervous system when processing new stimuli (Wedig, 2009). Stimulus reach the amygdala through either the thalamus or the cerebral cortex (Bailey, 2017). These stimuli create unconscious responses in the brain that triggers the sympathetic division of the peripheral nervous system, or the part of the nervous system that consists of cranial/spinal nerves and sensory/motor neurons (Bailey, 2017).

When the thalamus is exposed to new and unfamiliar stimuli, it sends this information to the cerebral cortex. The cerebral cortex is connected to the amygdala, which sends warning messages to the rest of the nerves and neurons in the body through the sympathetic division of

the autonomic nervous system. This is how the brain communicates with the rest of the body. This process causes us to have visceral reactions such as increased heart rate, dilated pupils, increased muscular blood flow and increased metabolic rate (Bailey, 2017). These physiological reactions are associated with several emotional states such as fear, anxiety or excitement. These unconscious, visceral reactions make us more alert to the new stimulus so we can discern if it is a threat to us or not. If we decide it is a threat, our fight or flight instincts kick in. If we decide it is not, when we are exposed to that stimuli again, we experience the same visceral reactions at a lower rate than we were exposed the first time (Wedig, 2009). This information, along with the visceral response that accompanies it, is then stored in the hippocampus, where we can access it later via memory (Phelps, 2004). Every time we are exposed to that stimuli, our rate of response drops because we remember that it won't harm us. This repeated experience over time deepens neural pathways associated with that particular stimuli, thus strengthening our understanding of the relationship between the stimulus and its effect on us.

Eventually, because we have been habituated to our memories of a certain causal relationship, we can predict outcomes with a certain degree of accuity. Because of this process, we waste less time and energy trying to discern whether we are threatened or not. It is a survival mechanism that enables us to 'filter out' non-life threatening stimuli from our consciousness-- if we know eating a certain plant will not make us sick, we won't be alarmed by that plant in the future. We know not to waste time trying to figure out if it will make us sick, because we have already experienced the effect this plant will have on us. The more times we eat the plant and do not get sick, the more reinforced this relationship becomes, until we develop an automatic expectation of it. Sound familiar? This process outlines our understanding of a causal

relationship. If I eat this plant (cause), I will not get sick (effect). We see the same response decrement due to increased exposure to a cause-effect relationship as Hume postulated in contemporary neuroscience.

When one begins to closely investigate and compare the particulars of Hume's Copy Principle to the mechanics outlined in contemporary neuroscience, the parallels that exist are remarkably clear. The process of impressions being processed and copied into ideas we access through the memory is corroborated by the structure of the brain. The sensory information received by the thalamus can be likened to Humean impressions. The amygdala tells us how to respond to impressions by viscerally communicating to us with somatic signs such as increased blood flow and heart rate and emotional signs like fear, aversion or relief. It's a survival mechanism that physically reacts to unfamiliar stimuli in the environment in order to let us know on a primal level to avoid painful or dangerous situations and seek pleasure and safety. This process is similar to the experience of direct passions described by Hume, which cause instantaneous reactions in response to pain or pleasure. We have access to the information the thalamus is exposed to and the amygdala processes because we form a memory of it that is stored in the hippocampus. The hippocampus associates these memories with emotions or sensations that were experienced with the actual event that is the object of the memory. Similarly, Hume believes we gain access to impressions through our memory of ideas, or mental copies of impressions. He believes these ideas are organized by a force of the mind he also calls association. Both Hume's theory and contemporary neuroscience also recognize the key role of habituation in strengthening and reestablishing these associations of ideas to build an understanding of the causal relationships. Neuroscience recognizes habituation as a response

decrement to repeated stimuli, which essentially means the visceral somatic and emotional reactions to a stimulus will decrease the more we are exposed to it. The response decrement tells us that we are learning the effects of the stimulus, so we are no longer surprised or alarmed by it. This neural process of habituation illustrates how we come to gain epistemic knowledge of a causal relationship, which corroborates Hume's theory. The amygdala is located in the limbic system of the brain, which is associated with memory, decision making, and emotional responses. Because of the hippocampus and the amygdala's locus in the limbic system, Hume was also correct about his concept of direct passions being the basis of our human actions.

Relevance

Hume's eighteenth theory withstanding the test of time in a discipline that is constantly evolving is truly remarkable, and a testament to the innovative exchange of ideas that characterized the Enlightenment. As one of the major figures in the empiricist movement, he believed that everything we need to know about the world exists out in the world-- we just need to get up and go find it. This attitude enabled him to turn the rigors of the scientific method to the philosophical pursuit of understanding human nature, and to utilize empirically grounded evidence in the development of his theories. Because of this, Hume had all of the tools he needed to create a theory regarding our knowledge of causality that can be verified with hard scientific evidence. As demonstrated in the previous section, his theory was remarkably spot on to the actual neural process that governs the human understanding. What makes this so extraordinary is the shift in the way we as human beings understand the world around us. Hume, along with Newton and similarly forward thinking intellectuals forever changed the way we approach some of life's biggest questions. The Enlightenment marks a shift from oppressive authoritative religions and monarchies telling people what to believe towards a rigorous, objective, and scientific uncovering of the truth in itself. While we as the human race still have a long way to go in shedding all of our superstitions in favor of reason, we definitely owe David Hume our thanks in helping us make progress.

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